

intestinal protozoa. Second, definite information as to their individual pathogenicity. Our ideas on this subject have been elaborated elsewhere.

Harry A. Wyckoff (closing)—It is indeed true that our knowledge relating to the pathogenicity of intestinal protozoa is very imperfect.

We have endeavored, in another place, to collect some facts in this connection, with a view to establishing a nucleus around which the results of further observation might be grouped. The present paper is the record of an attempt to utilize clinical material in carrying out this plan.

EFFECT OF STRUCTURAL CHANGES IN THE LUMBAR AND PELVIC REGIONS ON THE SCIATIC NERVE*

By HALBERT W. CHAPPEL, M. D., Los Angeles

Malformation, disease, or trauma of the lumbar spine or pelvis, may cause motor or sensory symptoms along the entire course of the sciatic nerve, or in a very limited area supplied by it. The lumbar vertebrae, five in number, are the largest of the movable vertebrae, the body having a greater diameter transversely than from before backward, with short thick laminae, a spinous process which projects horizontally backward, and slender transverse processes extending directly outward. The articular processes are thick and strong, and their articular surfaces are vertical, the superior, concave, look backward and inward, while the inferior, convex, look forward and outward. The movable vertebrae are joined together by elastic discs between the bodies, by synovial joints between the articular processes, and by strong ligaments. The fifth lumbar vertebra is joined to the first sacral vertebra by anterior and posterior ligaments of the bodies, capsular ligaments of the articular processes, the ligamenta subflava of the arches, supraspinous and interspinous ligaments, and by an intervertebral disc. The lateral lumbo-sacral ligament, and the ilio-lumbar ligament also add to the stability of the lumbo-sacral synchondrosis.

The sacrum, situated just below the last lumbar vertebra and articulating with it, in the adult is the union of five vertebrae. It also articulates laterally with the ilia, forming a complete joint with cartilage, synovial membrane ligaments, and supporting muscles and having slight but real motion of a sliding type. Inferiorly, the sacrum articulates with the coccyx. The ilium, together with the os pubis and ischium form the innominate bone and with its neighbor of the opposite side complete the bony formation of the pelvis.

The line of weight bearing, which passes to the innominate bones through the lumbar vertebrae and sacrum, is not a vertical one, and in the erect posture there is a constant tendency for the fifth lumbar vertebra to sag forward and downward on the sacrum, being prevented normally by muscular and ligamentous action, and by maintaining the normal curves of the spinal column.

The sciatic nerve, the longest and most widely distributed in the human body, originates in the

fourth and fifth lumbar roots and the first, second, and third sacral roots, the branches from which form the lumbo-sacral cord, uniting at the level of the sciatic notch. Passing around the ischial spine, it descends in the posterior part of the buttocks between the ischium and great trochanter, to and down the posterior aspect of the thigh, becoming superficial at the upper end of the popliteal space, where it divides into the external popliteal and internal popliteal nerves which supply the motor and sensory regions below the knee. The sacral plexus and its branches before uniting to form the sciatic nerve, lie very close to the lower lumbar spine, the lumbo-sacral articulation and the sacro-iliac synchondrosis.

Congenital variations of the sacrum and fifth lumbar vertebra are quite common. A fifth lumbar vertebra or a first sacral vertebra, normal on one side, may closely resemble the normal first sacral vertebra or fifth lumbar vertebra on the opposite side or the same development variations may be present on both sides, making it difficult to differentiate between the lumbar and sacral types of vertebrae.

Changes of the articular surface in the lumbo-sacral joint or joints, from the normal vertical to a horizontal axis, cause a chronic inflammation, and thus a thickening of the structures supporting those joints.

Occasionally the coalescence of the laminae is not completed, leaving a cleft in the arches of the vertebrae through which there may be a protrusion of the whole or a part of the spinal cord. This malformation is known as spina bifida, and is considered by many to be the most common of all congenital abnormalities of the vertebral column. A very important form is spina bifida occulta, where the laminae have just failed to meet and the membrane over the opening is strong enough to resist the intraspinal pressure. Frequently this form never gives symptoms, but troublesome claw feet, weakness of the lower extremities, and trophic disturbances developed after a few years and are believed to be directly caused by it.

A fifth lumbar vertebra situated abnormally low, especially when one of its transverse processes impinges on the ilium, a wedge-shaped fifth lumbar vertebra causing an abrupt lateral deviation of the lumbar spine with marked rotation or a congenital absence of the sacrum are sources of irritation to the lumbo-sacral cord.

Ryerson reported a case of recurrent spondylolisthesis with paralysis of the spastic type. He says: "It is quite true that it is not easy to constrict the spinal canal at the level of the fifth lumbar vertebra, but it can be done, and I can think of no other method by which this little girl's paraplegia could have been caused." From this it would seem possible to have a forward and downward displacement of the fifth lumbar vertebra on the sacrum sufficient to give pressure symptoms of the sciatic nerve. In nearly every case of true spondylolisthesis, there is a congenital malformation of the fifth lumbar vertebra, usually a non-fusion of the laminae, which makes it more prone to dislocation than that of a normally formed vertebra.

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Structural changes of the lumbar spine due to necrosis of the bones and collapse of the bodies of the vertebrae in Pott's disease are rarely the cause of the nerve symptoms. Pressure on the cord and nerve roots from the inflammatory material, mostly granulation tissue and thickened spinal membranes, slowly produces sensory and motor symptoms along the entire course of the sciatic nerve. An abscess, which usually follows the course of the psoas muscle, not only relieves the pressure symptoms, but removes the broken-down granulation tissue and carious bone from the diseased area.

Tumors of the lumbar spine and pelvic region rarely exist without producing symptoms of the sciatic nerve. When the bone is involved structural changes are marked, and nerve tissue is destroyed very rapidly.

Osteoarthritis involving the lower lumbar vertebrae, the lumbo-sacral articulation, or the sacro-iliac joints, is a very common cause of sciatic nerve symptoms. Although the Roentgen ray usually reveals osteophytes varying in size from the minutest roughening to well-developed spurs, or even bony fusion of two or more vertebrae, it occasionally fails to show any abnormality which can be demonstrated by means of the Roentgen ray. Recent literature has reported the presence of osteophytes on the bodies of lumbar vertebrae at autopsy that did not show in clear roentgenograms of the same region taken shortly before death. It is not only the pressure from the osteophytes, but the inflammation which stimulates their growth that irritates the nerve roots. Very minute structural changes may be responsible for severe nerve symptoms.

Traumatic separation of the symphysis pubis, as from a forceps delivery, gives a corresponding twist at one or both sacro-iliac joints, with pressure symptoms of the sciatic nerve. The inflammation resulting from subluxation of the sacro-iliac synchondrosis frequently irritates the sciatic nerve, although all the symptoms may be confined to the region of that joint.

Fracture of the bodies of the lumbar vertebra usually does not affect the sciatic nerve. Rarely an excess of callous impinges on the nerve roots. When the neural arch has been fractured, motor and sensory disturbances of the lower extremities are quite common.

Because of the close proximity of the lumbo-sacral cord to the transverse process of the fifth lumbar vertebra or to the lateral lumbo-sacro articulation, fracture of either usually produces enough callous to cause marked irritation to the sciatic nerve, and occasionally partial or total paralysis. Again, there may be no effect on the sciatic nerve when there was not only complete destruction of the fifth lumbar vertebra, but the transverse processes of all the lumbar vertebrae on one side were fractured and widely separated from the bodies, and the lumbar vertebrae sharply rotated. One month after the accident this patient was allowed to walk without spinal support. Nerve symptoms developed, which disappeared soon after rest in the recumbent position was resumed. Later a Hibbs' spinal fusion bridged the space between

the fourth lumbar vertebra and the sacrum and completely stabilized the lumbo-sacral articulation.

As injury to the sciatic nerve from direct pressure or irritation from inflammation near it may produce paralytic, neuritic, neuralgic, and causalgic syndromes, a thorough clinical and X-ray search for structural changes in the lumbar spine and pelvic region should be a routine in every case of sciatic nerve symptoms.

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DISCUSSION

Harold H. Hitchcock, M. D. (1906 Franklin Street, Oakland, Calif.)—The vicious habit of standing, as so many people do, with their pelvis tilted forward, their abdominal and gluteal muscles relaxed, and their lumbar lordosis greatly increased, together with anomalies of the articulations between the last lumbar vertebra and the sacrum, as pointed out by Goldthwait, I believe are great factors in making low backs less stable. It has not been my experience to see failure of union of the posterior laminae in spondylolisthesis. The failure of the laminae of the last lumbar vertebra to unite is a very common anomaly, and I believe it a coincidence when seen in spondylolisthesis. The variations in the articular facets are of more importance as a factor predisposing spondylolisthesis.

As in hip disease, referred pain is often felt in the knee, so I believe that much of the sciatic pain seen in patients with low back trouble is referred pain from either a lumbo-sacral or sacro-iliac lesion, and that the sciatic pain is not often caused by direct pressure on the sciatic or the nerve roots composing it.

Henry H. Lissner, M. D. (Brockman Building, Los Angeles)—It is not my intention to belittle the more recent advances made in the study of the causes of backache and sciatic pain, but it is my purpose to call attention to the usual psychological stimulus attendant upon all of the newer developments, in either medicine or surgery, and to warn against an ultra enthusiasm which leads the medical mind into a blind alley. Of course, not every backache, following trauma or otherwise noted, is due to spondylolisthesis; and not every pain in the region of the sciatic nerve or referred along its anatomical distribution is due to disease or inflammation of the nerve itself.

From the diagnostic standpoint we must consider conditions within the nerve, the effects of toxic absorption, and conditions without the nerve, which may cause pressure upon it to produce symptoms referable to it.

Sciatica per se is too well known to discuss in extenso. One point must be considered, namely, if there is localized atrophy of a group of muscles, it is suggestive that there is something more than a simple sciatica or neuritis at work. One must also be satisfied that there is no disease in the hip-joint, pelvis or spinal column which could give rise to symptoms.

Rectal and vaginal examinations should be made to be sure that no pelvic inflammatory or malignant mass is pressing, or that a retroverted uterus is not causing the trouble. Tuberculosis, gumma or malignant disease of the lumbo-sacral vertebra may produce pains resembling sciatica. A careful study of the urine and blood should be made for sugar, since double sciatica is not at all uncommon in diabetes.

Every man should investigate the action of the sphincters and palpate carefully the pelvis and spine, make rectal and vaginal examinations in all patients whose symptoms conform to a sciatic involvement and should have X-ray studies made, both antero-posterior and lateral views, after all other conditions have been excluded from the diagnostic standpoint.

Finally, don't let the X-ray examination be the

first step toward the diagnosis of conditions involving the lumbar and pelvic regions.

Maynard C. Harding, M. D. (Timken Building, San Diego)—Doctor Chappel has given us a surprising amount of information in a very condensed and understandable form. I wish to comment on only two points. The first is, why should injuries to the lumbo-sacral and sacro-iliac joints give pain in the sciatic distribution? In the first place, the typical radiation of sacro-iliac pain is down the back of the thigh to the popliteal space. This is the skin distribution of the small sciatic nerve, not of the great. It is inconceivable to me that the very slight gross movement which takes place in the ordinary sacro-iliac subluxation can cause actual damage by pressure or stretch. We must look for the origin of the nerve supply for explanation.

The sacro-iliac joint is supplied by twigs from the superior gluteal nerve, which arises from the fourth and fifth lumbar and first sacral nerves. Also by unnamed twigs of the sacral plexus arising at the same level. It receives another innervation from the primary posterior branches of the first and second sacral nerves. The skin covering this area is usually a seat of pain in sacro-iliac conditions, and is also supplied by the same primary posterior branches. The small sciatic arises from the posterior cords of the second and third sacral nerves. I believe it is this close segmental relation of these nerves which accounts for the distribution of pain.

My other point concerns the differential diagnosis between sciatic pain from sacro-iliac injury, and from toxemia, and inflammation.

In sacro-iliac slip the pain comes suddenly, it may go suddenly, or persist as a soreness a day or more after relief of the cause. There is rarely localized tenderness along the nerve, and never severe. There may or may not be a positive Kernig. In toxic pain, the pain comes more gradually. It pains in all postures. It is not relieved suddenly. Tenderness is moderate. There is usually a Kernig. In true inflammation the onset is gradual, and the relief is gradual. There is pain in all postures. Tenderness is marked, and the Kernig is marked and very painful.

Doctor Chappel (closing)—Since a discussion of all the causes for low back pains and sciatica would open up the whole realm of medicine and surgery, and as I fully appreciated that many conditions, aside from structural changes in the lumbar spine and pelvic region, may cause irritation to the sciatic nerve, I purposely limited the contents of this paper to causes which are frequently overlooked when determining the etiology and outlining the treatment for sciatica.

Standardizing Reform—We should say that the trouble with the hygienists is that they are obsessed with the idea of standardizing the people with respect to keeping well.

It is one thing to reform rigorously our spelling and set up correct and fixed orthographic standards, but when it comes to reforming human beings it should be borne in mind that some folk ought to be beguiled into what would be sinful and damaging for others.

But alas! the professional reformer can never be induced to see problems from such an angle.

We are today so much in the hands of narrow propagandists of all kinds that there is absolutely no chance of rational procedure. Therefore, any further material reduction of our mortality rate, much as we should wish to see it, is hardly to be looked forward to with any assurance. If it does come about, it will be because of more or less fortuitous determinants.—Editorial, *The Medical Times*, November, 1923.

TRAUMATIC SYNOVITIS OF THE KNEE, ACUTE AND CHRONIC*

(A Review of the Literature.)

By RUDOLPH L. DRESEL, M. D., San Francisco

In this paper I have tried to limit myself to the purely traumatic affections of the knee-joint, not those due to disease such as tuberculosis, hemophilia, or infectious arthritis, or those due to strain, such as so-called villous arthritis, which might influence the existing lesion.

Anatomy—The knee-joint is a hinge-joint, with some slight degree of ant-posterior motion as well as some slight rotation. It depends for its strength on its ligaments and on its muscles. It has two articulations, femoral-tibial and femoral-patellar. There is a capsule thickest behind and thin at the lateral aspects of the patella. There is an external and internal lateral ligament and two crucial ligaments. The tendon of the biceps strengthens the outside of the joint and reinforces the external lateral ligament. The ligament is separate from the capsule except behind, and it is separate from the external semi-lunar cartilage by the tendon of the popliteus muscle, and a bursa. The capsule mingles with the periosteum, reaches in front as the quadriceps pouch around as high as the lateral tuberosities, and in back one cm. above the cartilage covering the condyles, attached around the articular surface of the patella and down slightly on the sides of the tibia. On each side there are strong bands running from the condyles to the patella, the vasti and the fascia lata. The heads of the gastrocnemius, and some fibers of the tendon of the semimembranosus help to strengthen the capsule. The internal lateral ligament is very closely attached to the capsule and only artificially separated from it. The vastus internus fibers are inserted low enough on the internal capsule to cause in certain positions of the knee-joint, and under certain conditions of muscular contraction, a distortion of the internal capsule and the semi-lunar cartilage attached to it.

In traumatic affections of the knee-joint it is important to keep in mind the difference between the internal lateral ligament and the external, and the difference between the internal semi-lunar and the external, which makes considerable difference in the susceptibility for injury to the joint.

The external semi-lunar joins at its posterior horn to the posterior crucial ligament. There is no more than one centimeter between the two horns. The coronary ligament connects the cartilage to the tibia, it is not very strong and allows some motion, that on the outer semi-lunar being 2 centimeters in front and 2.5 centimeters in the back, thus allowing fairly free motion. The popliteus muscle separates the cartilage from the external lateral ligament.

The internal semi-lunar is C-shaped and has no definite attachment in front. It is sometimes free and at other times it is attached to the rough sides of the tibia at no particular point. The peripheral border of the internal semi-lunar is attached to the internal lateral ligament, the posterior horn is at-

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